



Development of a zero-dimensional mesoscale thermal model for urban climate

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Abstract:

A simple energy balance model is created for use in developing mitigation strategies for the urban heat island effect. The model is initially applied to the city of Phoenix, Arizona. There are six primary contributions to the overall energy balance: incident solar radiation, anthropogenic heat input, conduction heat loss, outgoing evapotranspiration, outgoing convection, and outgoing emitted radiation. Meteorological data are input to the model, which then computes an urban characteristic temperature at a calculated time step for a specified time range. The model temperature is shown to have the same periodic behavior as the experimentally measured air temperatures. Predicted temperature changes, caused by increasing the average urban albedo, agree within 0.1°C with comparable maximum surface temperature predictions from the fifth-generation Pennsylvania State University-National Center for Atmospheric Research Mesoscale Model (MM5). The present model, while maintaining valid energy-balance physics, allows users to quickly and easily predict the relative effects of urban heat island mitigation measures. Representative mitigation strategies, namely changes in average albedo and long-wavelength emissivity are presented here. Increasing the albedo leads to the greater reduction in daytime maximum temperatures; increasing the emissivity leads to a greater reduction in nighttime minimum temperatures. © 2009 American Meteorological Society.

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Resource Description

Climate Scenario :

specification of climate scenario (set of assumptions about future states related to climate)

Other Climate Scenario

Other Climate Scenario: author defined scenarios

Exposure :

weather or climate related pathway by which climate change affects health

Meteorological Factors, Solar Radiation, Temperature, Other Exposure

Temperature: Extreme Heat, Fluctuations

Other Exposure: evapotranspiration

Geographic Feature:

Climate Change and Human Health Literature Portal



resource focuses on specific type of geography

Desert, Urban

Geographic Location:

resource focuses on specific location

United States

Health Impact:

specification of health effect or disease related to climate change exposure

Health Outcome Unspecified

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Mitigation

Model/Methodology:

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type:

format or standard characteristic of resource

Research Article

Timescale:

time period studied

Time Scale Unspecified